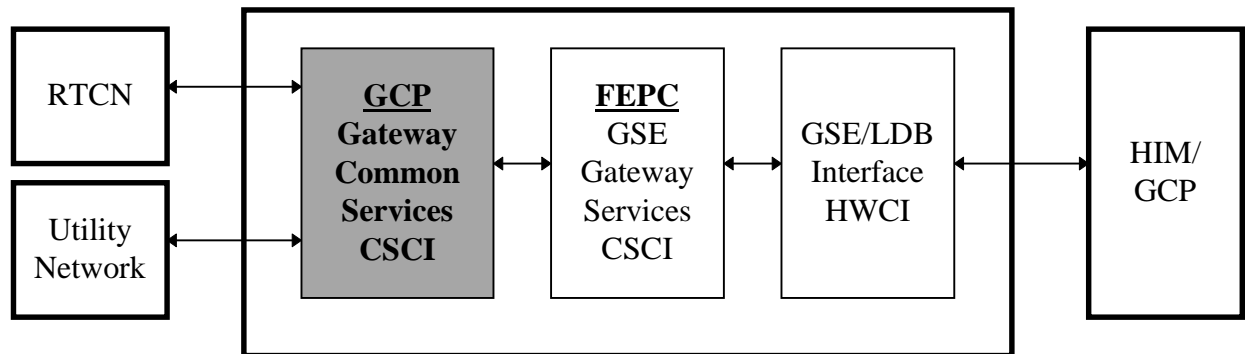# 1. Gateway Common Services CSCI

1.1 Gateway Common Services CSCI Introduction

1.1.1 Gateway Common Services CSCI Overview

The Gateway Common Services CSCI provides the essential functions to make any CLCS gateway operational. It is resident in the Gateway Control Processor (GCP). The Gateway Common Services CSCI is composed of multiple concurrent tasks that perform individual functions in order to support all the resources in the Gateway.

1.1.2 Gateway Common Services CSCI Operational Description

The Gateway Common Services CSCI is initiated by the Real Time Operating System (RTOS) resident on the Gateway's local disk. Initially it will spawn all the necessary tasks to support the Gateway services.
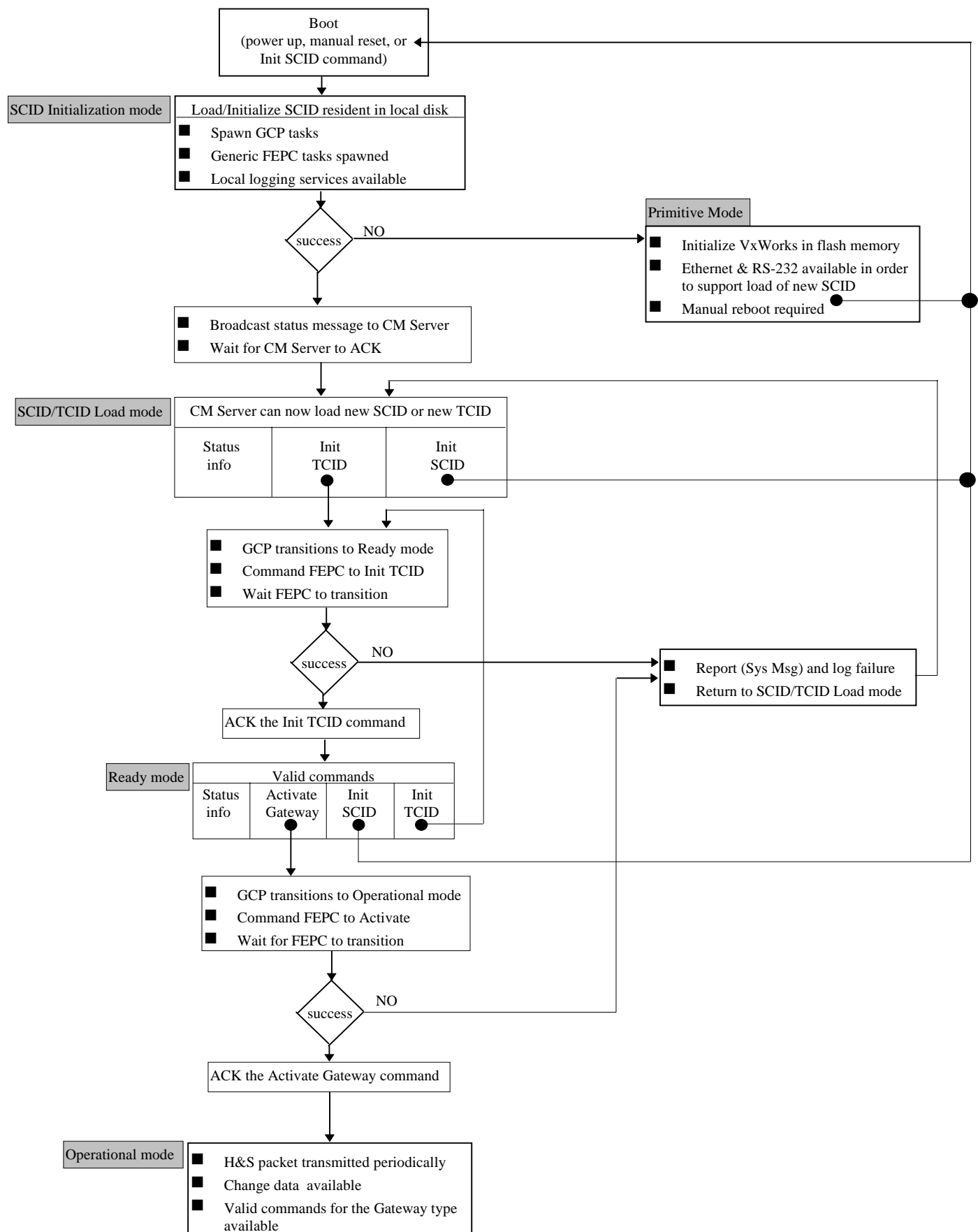
Commands are received asynchronously over the RTCN. Commands may be one of several types (e.g. Table Maintenance, Load / Initialize, end item commands (Data Bus), etc.). In all cases a response is returned to the issuer of the command. End item commands are routed to the FEPC command queue. The Redstone delivery will support only Data Bus and Load / Initialization commands over the RTCN.

1.1.3 Gateway Common Services CSCI Operating Modes

The Gateway Common Services will transition through four (4) normal modes before being fully operational (SCID Initialization, SCID/TCID Load, Ready, and Operational). In case of an error during boot, the Gateway will transition to a Primitive mode in order to support re-loading of the SCID via the Utility Network (ethernet).

- Gateway Common Services operating modes:
  - SCID Initialization mode (boot or reboot)
    - The Gateway enters this mode via power-up, manual reset, or by CLCS command (Init SCID command).
    - VxWorks Boot Software (in FLASH) loads SCID from local hard disk.
    - Gateway Common Services CSCI initializes and spawns appropriate tasks on GCP.
    - The RTCN Interface is initialized at this time.
    - FEPC Spawns Init task. No Gateway specific FEPC software is operating at this time (i.e. no software to communicate to a GDB interface hardware or to process End Item Commands).
    - If SCID initialization was successful, Gateway Common Services CSCI broadcasts status message to CM Server indicating successful SCID Initialization. If the SCID initialization fails, the Gateway will attempt to boot the VxWorks operating system loaded into flash and will enter 'Primitive' mode.
    - CM Server acknowledges status message. The acknowledgment instructs Gateway to enter 'SCID/TCID Load' mode.
  - Primitive mode

- This is not a normal state for the Gateway. If the SCID initialization fails, the Gateway will attempt to boot the minimal VxWorks operating system loaded into flash and will enter the 'Primitive' mode. SCID initialization failure could result if the SCID file transfer was corrupted or the hard disk was not accessible.
- The Gateway will only be accessible via a Telnet or FTP session across the Gateway Group Utility Network or via the console port (RS-232) and a terminal.
- The RTCN interface will not be initialized and will not be functional.
- The Gateway will not accept CLCS Commands.
- The Gateway Status information will not be available via the RTCN.
- This state is intended to allow a new SCID to be loaded manually on the local hard disk via an FTP session across the Gateway Group Utility Network. A manual re-boot will be executed and the Gateway will attempt to enter the SCID Initialization mode.

- SCID/TCID Load mode
  - After receipt of the SCID Initialization Acknowledge from the CM Server, the Gateway enters the SCID/TCID Load mode. This is the normal mode when the Gateway is not in the 'Ready' mode or 'Operational' mode.
  - At this point, the Gateway is ready to receive normal Commands from the CM Server and to provide status information upon request via the RTCN.
  - 'End Item' commands will not be accepted.
  - This mode is intended to allow the Gateway to be polled for Status via the RTCN and to allow a new SCID or TCID to be loaded from the CM server to the Gateway's local hard disk via FTP 'put'.
  - SCID or TCID loads will verified by the CM Server via FTP 'get'.
  - Other than requests for status, the Gateway would normally receive an 'Init TCID' or 'Init SCID' command.
  - The 'Init SCID' command instructs the Gateway to re-boot and to enter the 'SCID Initialization Mode'.
  - The 'Init TCID' command instructs the GCP and the FEPC to load TCID tables off the local hard disk.
  - If TCID Initialization is successful, the Gateway transmits status to the CM server and enters the 'Ready' mode.
  - If TCID Initialization fails, the Gateway transmits status to the CM server and stays in the 'SCID/TCID Load' mode.

- Ready mode
  - At this point the Gateway successfully booted from the SCID and initialized TCID tables.
  - The Gateway will continue to process a very limited set of commands: requests for status, 'Init SCID', 'Init TCID' and 'Activate Gateway'.
  - 'End Item' commands will not be processed.
  - If the Init SCID command is received, the Gateway will enter the 'SCID Initialization' mode
  - If the Init TCID command is received, the Gateway will enter the 'SCID/TCID Load' mode.
  - Normally the next command expected to be received is 'Activate Gateway'. The Activate Gateway command instructs the Gateway to spawn all Gateway specific tasks on the FEPC required for normal operation.
  - Upon successful initialization of the FEPC tasks, the Gateway transmits status to the CM server and enters the 'Operational' mode.
  - If FEPC task initialization was not successful, the Gateway transmits appropriate status to the CM server and returns to the 'SCID/TCID Load' mode.

- Operational mode
  - At this point, the Gateway will process all normal Commands.
  - Typically, the 'Activate Data Acquisition Command' would be sent to the Gateway by the CCP to begin processing data.
  - The 'Inhibit Data Acquisition' Command is used to terminate Gateway measurement processing.
  - 'De-Activate Gateway' Command instructs the Gateway to transition back to 'Ready Mode'.

Boot
(power up, manual reset, or Init SCID command)

Load/Initialize SCID resident in local disk
- Spawn GCP tasks
- Generic FEPC tasks spawned
- Local logging services available

success — NO →

Primitive Mode
- Initialize VxWorks in flash memory
- Ethernet & RS-232 available in order to support load of new SCID
- Manual reboot required

- Broadcast status message to CM Server
- Wait for CM Server to ACK

SCID/TCID Load mode

CM Server can now load new SCID or new TCID

Status info	Init TCID	Init SCID

- GCP transitions to Ready mode
- Command FEPC to Init TCID
- Wait FEPC to transition

success — NO →

- Report (Sys Msg) and log failure
- Return to SCID/TCID Load mode

ACK the Init TCID command

Ready mode

Valid commands

Status info	Activate Gateway	Init SCID	Init TCID

- GCP transitions to Operational mode
- Command FEPC to Activate
- Wait for FEPC to transition

success — NO →

ACK the Activate Gateway command

Operational mode
- H&S packet transmitted periodically
- Change data available
- Valid commands for the Gateway type available

1.1.4 Gateway Common Services CSCI Computer Software Components

Gateway Common Services CSCI is composed of the following CSCs:

- Gateway Initialization/Re-initialization CSC

- Gateway Command and Response CSC

- Gateway Table load, Initialization, and Maintenance CSC (removed)

- Gateway RTCN Utilities CSC

- Gateway Timer Services CSC

- Gateway Overall Health & Status CSC (not required for Redstone)

- Gateway Utility Request CSC

- Gateway Maintenance User Interface CSC

## 1.1.5 Gateway Common Services CSCI Data Flow/Interface Diagram
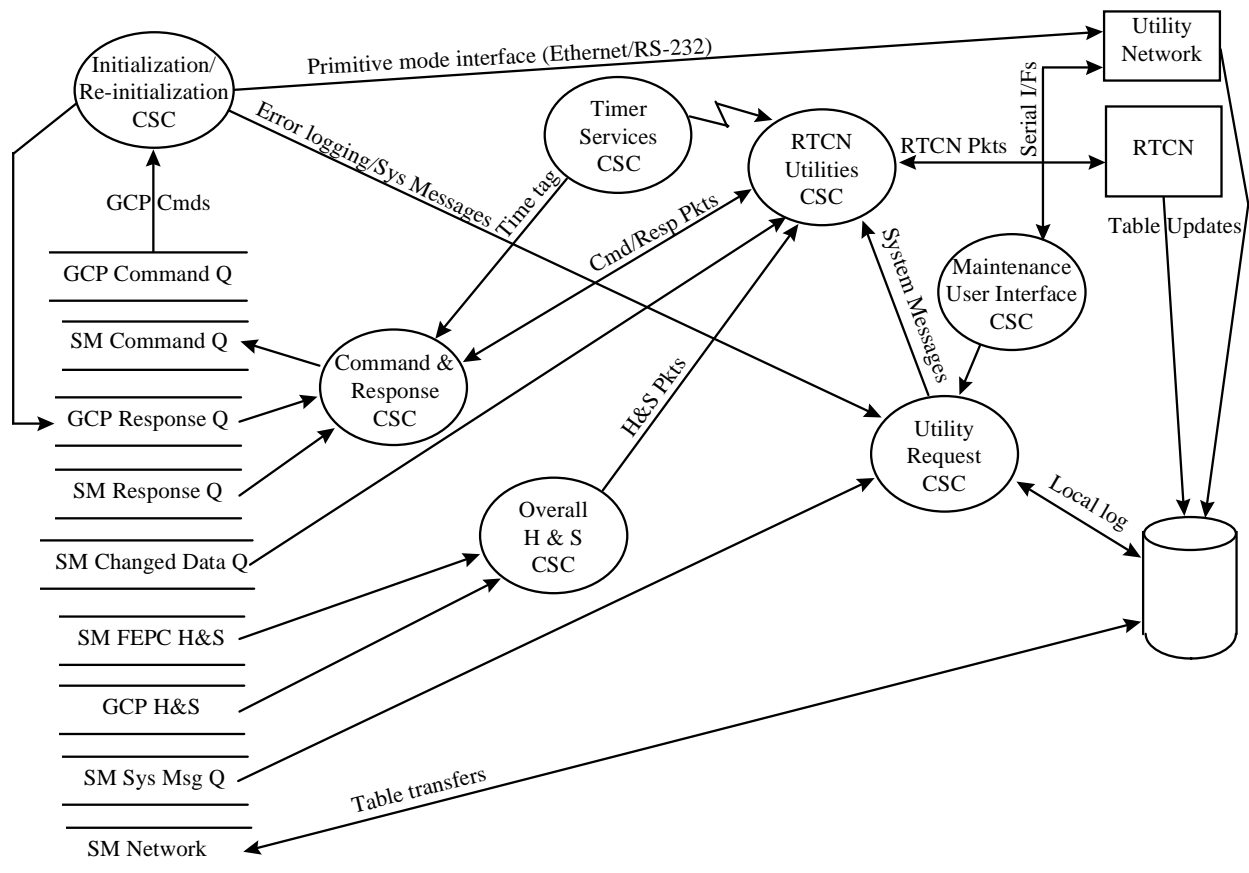
1.2 Gateway Initialization/Re-initialization CSC

1.2.1 Gateway Initialization/Re-initialization CSC Introduction

1.2.1.1 Gateway Initialization/Re-initialization CSC Overview

The Gateway Initialization/Re-initialization CSC is responsible for the initialization sequence of the Gateway. It is part of the Gateway Common Services CSCI and is resident in the GCP.

Gateway Common Services CSCI
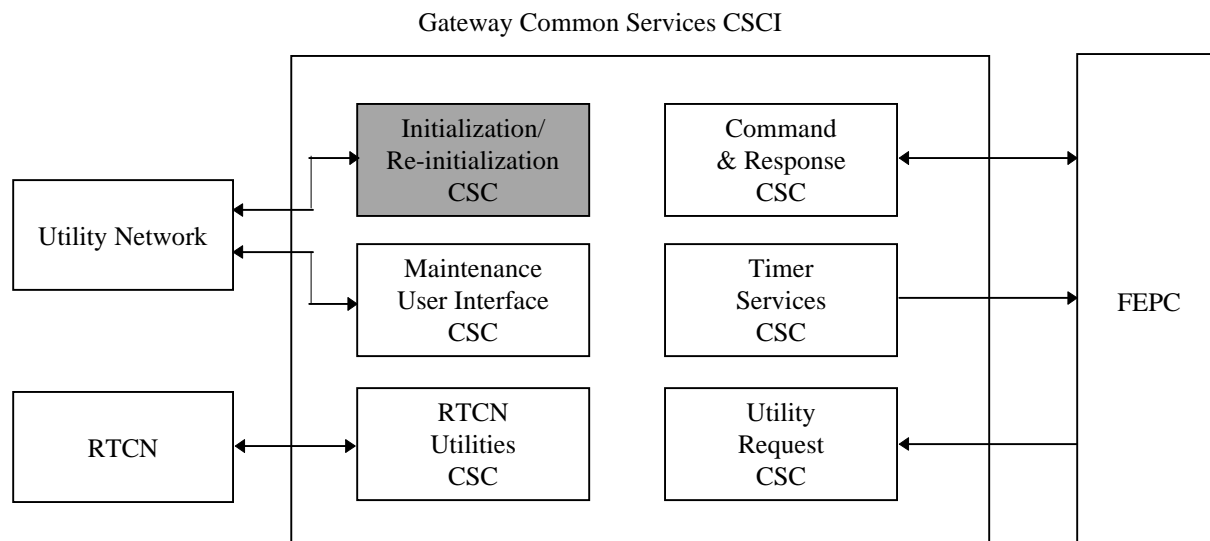
1.2.1.2 Gateway Initialization/Re-initialization CSC Operational Description

The Gateway Initialization/Re-initialization CSC controls the initialization sequence of the Gateway. The Gateway's initialization sequence is divided into four (4) modes of operation that allow a synchronized boot sequence between all the Single Board Computers resident in the Gateway.

1.2.2 Gateway Initialization/Re-initialization CSC Specifications

1.2.2.1 Gateway Initialization/Re-initialization CSC Groundrules

- SCID and TCID tables will be resident on the local hard drive.

- Initial SCID will be loaded via utility port during initial Gateway installation.

- The Gateway Initialization/Re-initialization CSC will support the following modes of operation in order to synchronize the Gateway's boot sequence:
  - SCID Initialization
  - SCID/TCID Load
  - Ready
  - Operational

- The initialization modes interface with the rest of the system via the RTCN.

- In case of a boot failure, the Gateway will transition to the 'Primitive mode' in order to allow a new SCID to be loaded.

- The Primitive mode will support communications via the ethernet and the console port.

- The Gateway Initialization/Re-initialization CSC will support the following initialize commands:
  – Init SCID
  – Init TCID
  – Activate Gateway
  – Terminate Gateway

- For Redstone, configuration commands such as Activate Data Acquisition and Activate Global Commands will be supported via the Utility Network.

1.2.2.2 Gateway Initialization/Re-initialization CSC Functional Requirements

- Gateway Initialization/Re-initialization CSC shall support the following commands:
  – Init SCID (reboot)
  – Init TCID
  – Activate Gateway
  – Terminate Gateway

- Gateway Initialization/Re-initialization CSC shall record initialization messages on local storage media.

- No external commands shall be accepted during the SCID Initialization mode.

- Gateway Initialization/Re-initialization CSC shall transition to SCID/TCID Load mode when SCID software load is complete.

- When in SCID/TCID Load mode, only Init SCID and Init TCID commands shall be accepted.

- Gateway Initialization/Re-initialization CSC shall perform a reboot and enter SCID Initialization mode when the Init SCID command is received.

- Gateway Initialization/Re-initialization CSC shall transition to Ready mode when the GSE Gateway Services transition to Ready mode.

- Gateway Initialization/Re-initialization CSC shall transition to Operational mode when the GSE Gateway Services transition to Operational mode.

- When in Operational mode, the Init SCID, Init TCID and Activate Gateway shall not be accepted.

- Gateway Initialization/Re-initialization CSC shall terminate all tasks and enter SCID/TCID Load mode when the Terminate Gateway command is received.

- Gateway Initialization/Re-initialization CSC shall perform resource/memory de-allocation prior to returning to a previous mode.

- Gateway Initialization/Re-initialization CSC shall generate a system message prior to termination due to an error.

- Gateway Initialization/Re-initialization CSC shall record all termination messages on local storage media.

- Gateway Initialization/Re-initialization CSC shall generate a system message prior to termination (Terminate Gateway command).

1.2.2.3 Gateway Initialize/Re-initialize CSC Performance Requirements

No performance requirements have been identified for the Gateway Initialize/Re-initialize CSC for the Redstone delivery.

1.2.2.4 Gateway Initialization/Re-initialization CSC Interfaces/Data Flow Diagram

Refer to diagram in section 1.1.5.

1.3 Gateway Command and Response CSC

1.3.1 Gateway Command and Response CSC Introduction

The Gateway Command and Response CSC provides a communication path between the Gateway resident processors and the RTCN. The Gateway Command and Response CSC is a set of processes and tables residing on the Gateway Control Processor that conveys both command and response packets between the RTCN and the Gateway's processors.

1.3.1.1 Gateway Command and Response CSC Overview

Gateway Common Services CSCI
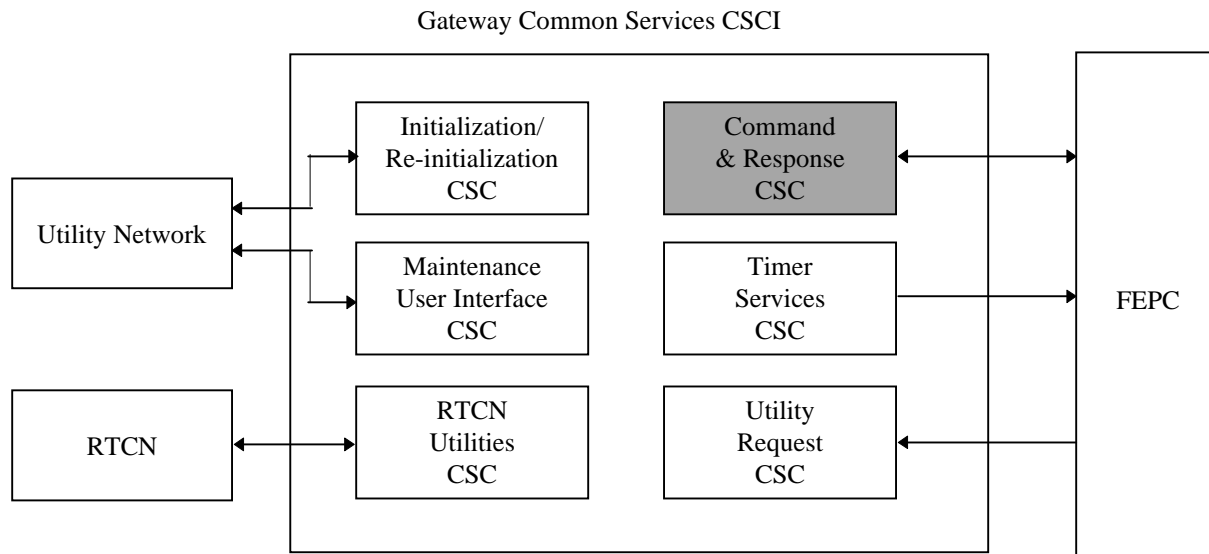
1.3.1.2 Gateway Command and Response CSC Operational Description

During Gateway initialization, each Gateway resident processor registers the specific command and response services it requires (e.g. route codes, command and response queues). All shared message queues, a routing table, and a transaction table are built using the registered information.

An incoming RTCN command is indexed into the routing table by its route code, stored in the transaction table if a response is required, checked for command priority, and relayed to the appropriate Gateway processor(s) command queues.   A Gateway processor generated response is indexed into the transaction table by transaction ID to verify a response was expected, and relayed to the RTCN.

The Gateway Command and Response CSC is also capable of relaying to the RTCN any commands issued by the Gateway resident processors, and handling the incoming responses associated with those commands. This feature will not be supported in the Redstone delivery.

1.3.2 Gateway Command and Response CSC Specifications

1.3.2.1 Gateway Command and Response CSC Groundrules

- Gateway Command and Response CSC will support an initialization shared memory message queue by which each Gateway resident processor may:
  - Register for specific Command and Response services.
  - Register its required route codes.

- Gateway Command and Response CSC will support all RTCN commands and responses including:
  - Commands received from the RTCN that need to be routed to more than one Gateway resident processor.
  - Commands that expect multiple responses.

- Gateway Command and Response CSC will build and maintain the following tables:
  - Route Table: Maps route codes to Gateway resident processors.
  - Transaction Table: Tracks commands and their associated required responses.

- Gateway Command and Response CSC communication will be implemented as follows:
  - Communication with the Gateway resident processors is by shared memory message queues.
  - Communication with the RTCN through the ATM Network Adapter Board is by the API provided by the Network Services CSCI.

- All Gateway generated commands and responses will be time stamped immediately prior to transfer to the RTCN. The time stamp will reflect the time the command/response left the gateway, not when processing occurred.

1.3.2.2 Gateway Command and Response CSC Functional Requirements

The Functional Requirements for Gateway Command and Response CSC are arranged in the following major/minor functions:

1. Initialization
2. Command Processing
3. Response Packet Building

I.   Initialization

A.   Gateway Command and Response CSC shall provide an initialization shared memory message queue for Gateway resident processor or GCP resident process registration.

B.   Gateway Command and Response CSC shall provide the following services to each Gateway resident processor and to GCP resident processes:

  1.   High and normal priority receive command queues.

  2.   Generate response queue.

  3.   Change data queue.

  4.   High and normal priority generate command queue.

  5.   Receive response queue.

  6.   Route code registration.

C.   Registration for any command queues shall result in the creation of both a high and normal priority queues.

D.   Gateway Command and Response CSC shall build and maintain a Route Table which will contain registered routes for each Gateway resident processor and GCP resident processes.

E.   Gateway Command and Response CSC shall build and maintain a Transaction Table which will track responses during command processing.

F.   For each requested response queue, Gateway Command and Response CSC shall spawn a task to monitor activity on the queue.

II.   Command Processing

A.   Gateway Command and Response shall receive commands asynchronously from the ATM Network Adapter Board using the API provided by Network Services CSCI.

B.   When an incoming command's route code is not found in the Route Table, a NACK will be returned to the command's source.

C.   When an incoming command's route code is found in the Route Table, the command shall be forwarded to each processor/process that registered for that route code.

D. When an incoming command has been designated as high priority, the command shall be placed in the appropriate processor(s)/process(es) high priority receive command queue.

E. When a received command expects a response, the command's header shall be copied into the Transaction Table for reference during Response Packet Building.

III. Response Packet Building

A. Gateway Command and Response CSC shall build and send response packets to the ATM Network Adapter Board using the API provided by the Network Services CSCI.

B. For each generate response queue, Gateway Command and Response CSC shall have a dedicated process to monitor queue activity.

C. Each generate response queue monitor shall read asynchronously from the shared memory message queues.

D. When a generated response is read from the shared memory message queues and not found in the Transaction Table, a System Message will be issued and TBD.

E. When a generated response is read from the shared memory message queues and found in the Transaction Table, Gateway Command and Response CSC shall time stamp the packet and write it to the RTCN.

F. When the generated response is one of several expected responses, the response shall be stored in the Transaction Table until all expected responses have been generated. At that time, Gateway Command and Response CSC shall time stamp and send the response to the RTCN.

G. When a routed command does not return a response within TBD, a NACK packet shall be returned to the CCP with a COMMAND TIMED OUT code.

1.3.2.3 Gateway Command and Response CSC Performance Requirements

I. Processing Speed

A. Gateway Command and Response CSC shall be capable of processing 500 commands per second.

II. Other

A. Gateway Command and Response CSC shall generate a system message prior to termination due to an error.

Note: No other Gateway Command and Response CSC performance requirements have been identified.

1.3.2.4 Gateway Command and Response CSC Interfaces/Data Flow Diagram

Refer to diagram in section 1.1.5.

1.4 Gateway Table load, Initialization, and Maintenance CSC

- The Gateway Table load, Initialization, and Maintenance CSC for the following reasons:

  – Table loads are handled by the CM Server
  – Table initialization is being handled by the Initialization/Re-Initialization CSC
  – Table maintenance is handled by the FEPC

1.5 Gateway RTCN Utilities CSC

1.5.1 Gateway RTCN Utilities CSC Introduction

1.5.1.1 Gateway RTCN Utilities CSC Overview

The Gateway RTCN Utilities CSC is responsible for the different utilities needed by the Gateway when interfacing with the RTCN. It is part of the Gateway Common Services CSCI and is resident in the GCP.

Gateway Common Services CSCI
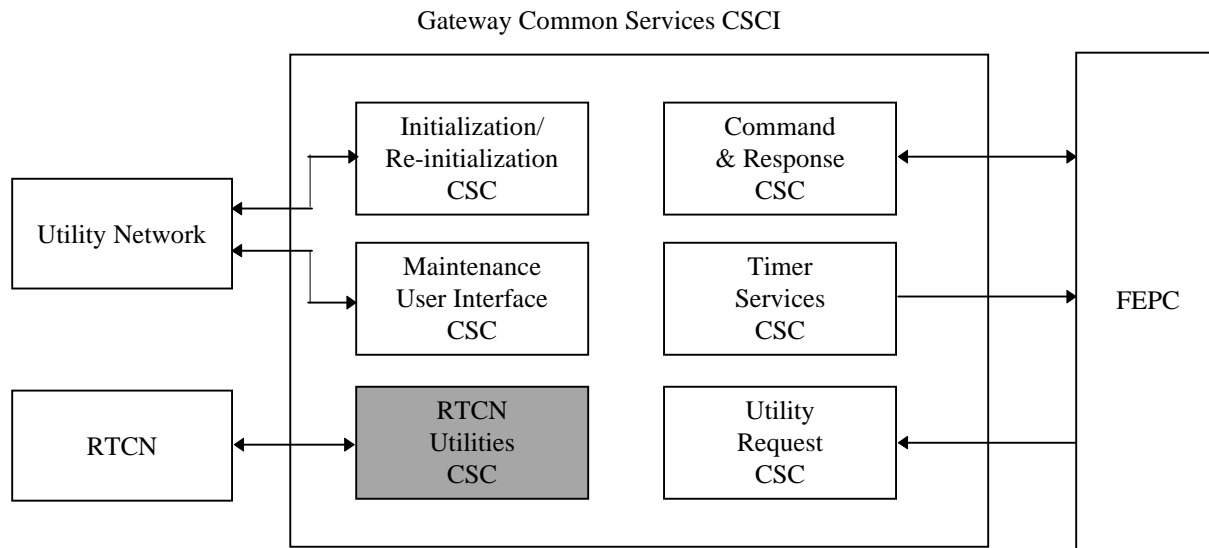
1.5.1.2 Gateway RTCN Utilities CSC Operational Description

The Gateway RTCN Utilities CSC contains the API provided by the Network Services CSCI which is used by the Gateway components when interfacing with the RTCN. Also, when interrupted by the Timer Services CSC, the Gateway RTCN Utilities CSC will build RTCN change data packets and transfer them to the RTCN. These RTCN change data packets contain change measurements provided by the FEPC.

1.5.2 Gateway RTCN Utilities CSC Specifications

1.5.2.1 Gateway RTCN Utilities CSC Groundrules

- The Network Services CSCI API library will be linked as part of the Gateway SCID.

- Timer Services CSC will interrupt RTCN Utilities CSC at the system synchronous rate.

- The system synchronous rate will be provided as part of the TCID.

- The FEPC will provide change measurements via the SM Change Data Queue.

- Change measurements are within the system synchronous rate period.

1.5.2.2 Gateway RTCN Utilities CSC Functional Requirements

- Gateway Table load, Initialization, and Maintenance CSC shall generate a system message prior to termination due to an error.

- The Gateway RTCN Utilities CSC shall provide change data packets to the RTCN at the system synchronous rate.

1.5.2.3 Gateway RTCN Utilities CSC Performance Requirements

- The Gateway RTCN Utilities CSC shall provide change data packets to the RTCN at the system synchronous rate.

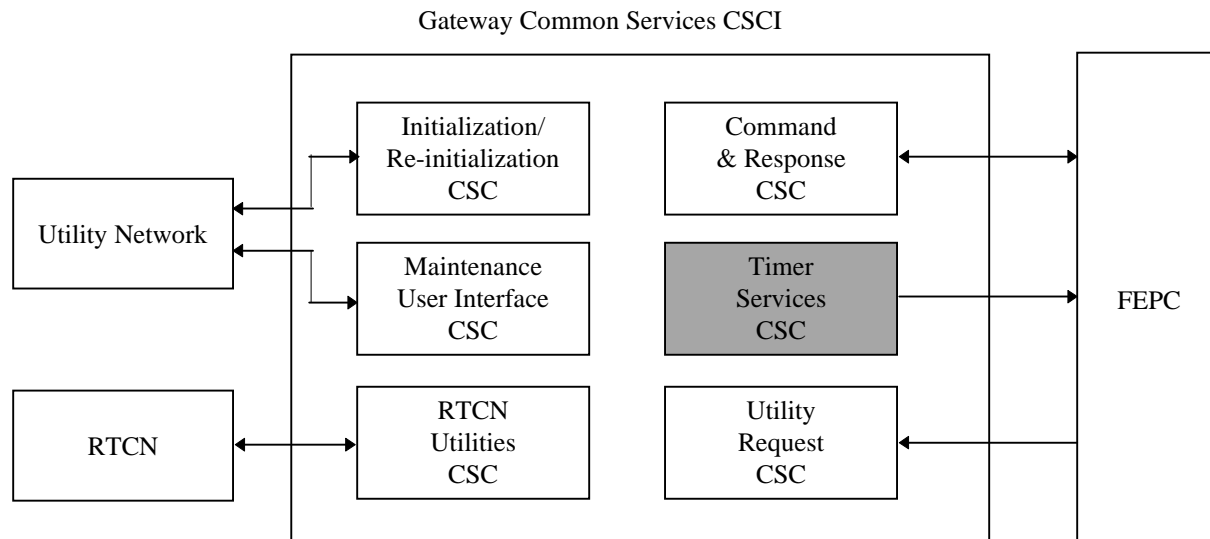### 1.5.2.4 Gateway RTCN Utilities CSC Interfaces/Data Flow Diagram

Refer to diagram in section 1.1.5.

1.6 Gateway Timer Services CSC

1.6.1 Gateway Timer Services CSC Introduction

1.6.1.1 Gateway Timer Services CSC Overview

The Gateway Timer Services CSC is responsible for the different services needed by the Gateway when interfacing with the time interface card. It is part of the Gateway Common Services CSCI and is resident in the GCP.

Gateway Common Services CSCI

```
          ┌──────────────────┐                    ┌──────────────┐
          │  Initialization/ │  │  Command     │
          │ Re-initialization│  │ & Response   │◄───►
          │       CSC        │  │     CSC      │
┌──────────┐  └──────────────────┘      └──────────────┘
│ Utility  │◄─
│ Network  │   ┌──────────────────┐      ┌──────────────┐
└──────────┘   │   Maintenance    │      │    Timer     │        ┌──────┐
               │  User Interface  │      │   Services   │───────►│ FEPC │
               │       CSC        │      │     CSC      │        └──────┘
               └──────────────────┘      └──────────────┘
┌──────────┐   ┌──────────────────┐      ┌──────────────┐
│   RTCN   │◄─►│      RTCN        │      │   Utility    │
│          │   │    Utilities     │      │   Request    │◄───
└──────────┘   │       CSC        │      │     CSC      │
               └──────────────────┘      └──────────────┘
```

1.6.1.2 Gateway Timer Services CSC Operational Description

The Gateway Timer Services CSC is responsible for providing the initialization routine for the time interface card. The Gateway Timer Services CSC will also provide services to read the time as provided by the time interface card.

1.6.2 Gateway Timer Services CSC Specifications

1.6.2.1 Gateway Timer Services CSC Groundrules

- Gateway Timer Services CSC will provide the initialization routine for the time interface card.

- Gateway Timer Services CSC will provide common services as part of the GCP Services API.

- GCP Services API will include:
  - Get time in BCD with micro-second resolution.
  - Get millisecond time of day (32-bit integer).
  - Get Julian time of year, JTOY (32-bit integer)

- The time interface card will use an external IRIG-B signal in order to synchronize the time of day.

1.6.2.2 Gateway Timer Services CSC Functional Requirements

- Gateway Timer Services CSC will interrupt the RTCN Utilities' Change Data Packet Builder at the system synchronous rate.

- Gateway Timer Services CSC shall generate a system message prior to termination due to an error.

1.6.2.3 Gateway Timer Services CSC Performance Requirements

- Gateway Timer Services CSC API will return time within 10μ seconds from the time of the call.

1.6.2.4 Gateway Timer Services CSC Interfaces/Data Flow Diagram

Refer to diagram in section 1.1.5.

1.7 Gateway Overall Health & Status CSC

- Gateway Overall Health & Status CSC not part of the Redstone baseline.

1.8 Gateway Utility Request CSC

1.8.1 Gateway Utility Request CSC Introduction

1.8.1.1 Gateway Utility Request CSC Overview

The Gateway Utility Request CSC is responsible for transmitting System Messages, error logging and status logging. It is part of the Gateway Common Services CSCI and is resident in the GCP.

Gateway Common Services CSCI
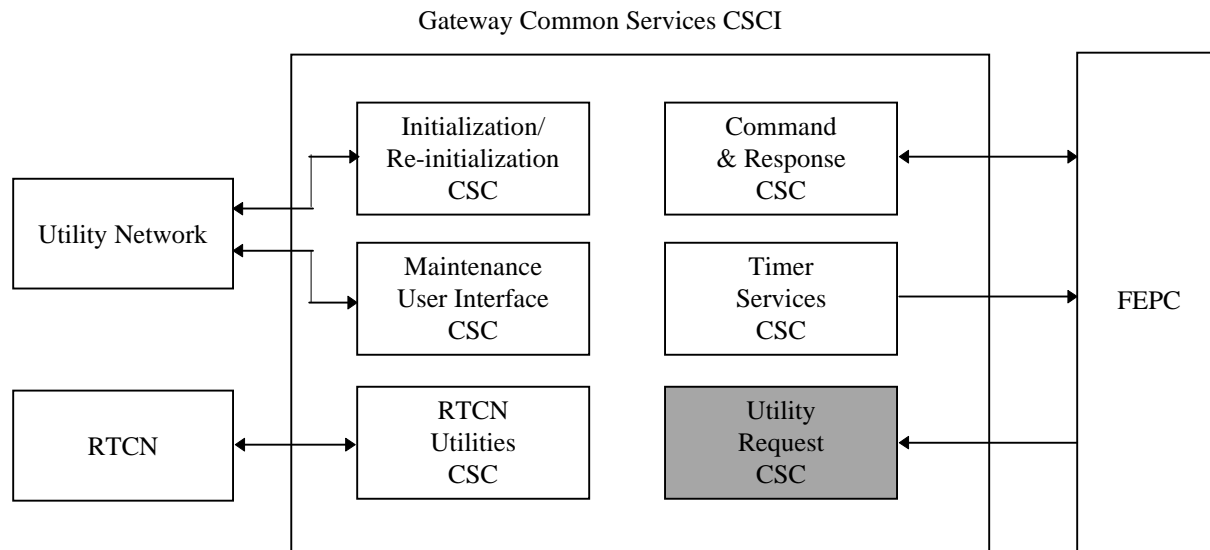
1.8.1.2 Gateway Utility Request CSC Operational Description

Gateway Utility Request CSC will provide the capability for any resource in the Gateway to generate System Messages via RTCN. It will also provide the capability to log error and status messages to local disk. These error and status message can also be routed to the console port.

1.8.2 Gateway Utility Request CSC Specifications

1.8.2.1 Gateway Utility Request CSC Groundrules

- Gateway Utility Request CSC will provide an API that will allow any resource in the Gateway to generate System Messages, log to local disk error/status messages, and route error/status messages to the console port.

- The message number and the message structure used to format System Messages will be defined in a header file that is used by the GCP and by the CLCS CCP to format the text output.

- This header file needs to be provided to the Gateway development team so that it can be included as part of the Gateway SCID build.

1.8.2.2 Gateway Utility Request CSC Functional Requirements

- Gateway Utility Request CSC shall provide a method for all resources in the Gateway to send System Messages via RTCN.

- Each System Message will contain the following minimum contents:
    - Source - CSCI/CSC Name or logical name of Gateway (e.g., GS1A) TBD
    - Message Number - from the ones listed in the header file
    - Severity Level (e.g., Information, Warning, Error)

- Message Group or Category (e.g., GSE)
- Message Parameters - (TBD)
- Time - (format TBD)

- Gateway Utility Request CSC shall time stamp each System Message using JTOY format (TBD).

- Gateway Utility Request CSC API shall return success or failure status back to calling CSC.

- Gateway Utility Request CSC API shall provide the capability for specifying message parameters.

- Gateway Utility Request CSC shall support a minimum of TBD message severity level classifications.

- Gateway Utility Request CSC shall define the Packet Payload content which includes an indicator specifying message is to be logged by SDC.

- Gateway Utility Request CSC shall distribute the message to multiple RTPS destinations and to the SDC for recording.

1.8.2.3 Gateway Utility Request CSC Performance Requirements

No performance requirements have been identified for the Gateway Utility Request CSC for the Redstone delivery.

### 1.8.2.4 Gateway Utility Request CSC Interfaces/Data Flow Diagram

Refer to diagram in section 1.1.5.

1.9 Gateway Maintenance User Interface CSC

1.9.1 Gateway Maintenance User Interface CSC Introduction

1.9.1.1 Gateway Maintenance User Interface CSC Overview

The Gateway Maintenance User Interface CSC allows access to the Gateway via the Utility Network. It is part of the Gateway Common Services CSCI and is resident in the GCP.

Gateway Common Services CSCI
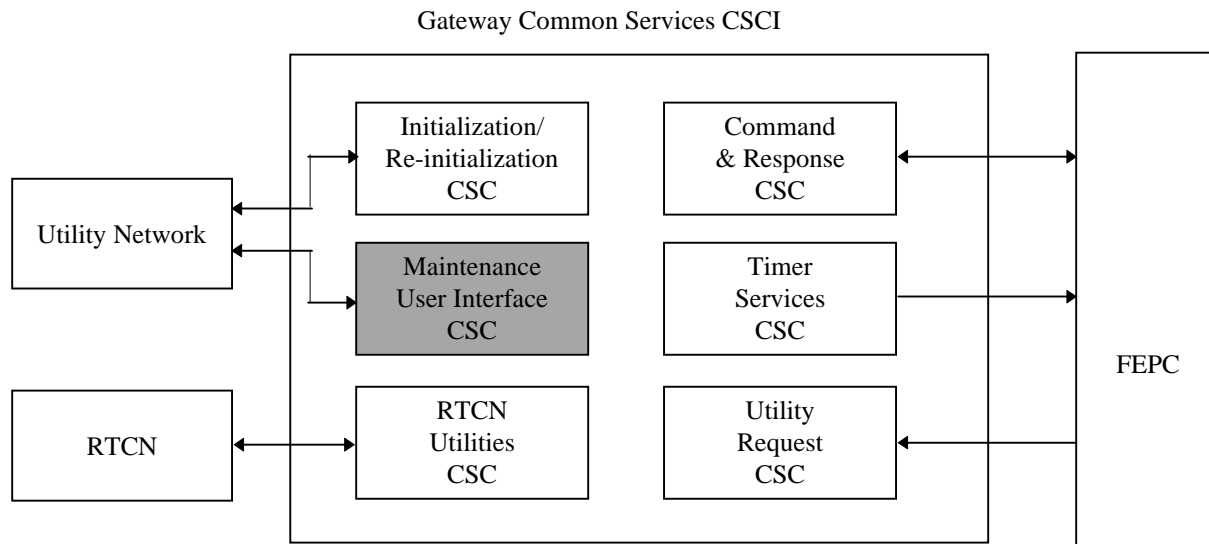
1.9.1.2 Gateway Maintenance User Interface CSC Operational Description

Gateway Maintenance User Interface CSC will allow access to the Gateway via the Utility Network (ethernet and RS-232) in order to load the initial SCID during Gateway installation. It will also allow access to Health and Status information via the Utility Network.

1.9.2 Gateway Maintenance User Interface CSC Specifications

1.9.2.1 Gateway Maintenance User Interface CSC Groundrules

- For Redstone, configuration commands such as Activate Data Acquisition and Activate Global Commands will be supported via the Utility Network.

- Gateway Maintenance User Interface CSC provides the Utility Network (ethernet and console port) access to the Gateway during installation, development, and operation.

- During the Gateway's installation, the initial SCID will be loaded using the Utility Network.

- If the Gateway transitions to the 'Primitive mode', the Utility Network will be the only means of communication with the Gateway.

- Gateway Health and Status information can be accessed via the Utility Network.

1.9.2.2 Gateway Maintenance User Interface CSC Functional Requirements

- Gateway Maintenance User Interface CSC shall generate a system message prior to termination due to an error.

- Gateway Maintenance User Interface CSC shall provide access to the Gateway via the Utility Network in order to support SCID load.

- Gateway Maintenance User Interface CSC shall provide access to the Gateway via the Utility Network when the Gateway is in the 'Primitive mode'.

1.9.2.3 Gateway Maintenance User Interface CSC Performance Requirements

No performance requirements have been identified for the Gateway Maintenance User Interface CSC for the Redstone delivery.

1.9.2.4 Gateway Maintenance User Interface CSC Interfaces/Data Flow Diagram

Refer to diagram in section 1.1.5.